

## A WIRELESS STORM DETECTOR FOR THE CENTRAL LIGHTING STATION.

By HERBERT T. WADE.

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At large power stations, such as that of the Waterside Station of the New York Edison Co., considerable difficulty in supplying sufficient current may arise with a sudden darkening of the sky at unusual times. This is often true of thunderstorms, when the sky will become dark almost without warning, and thousands of lights will be switched on all over the city almost instantly, increasing the load to such an extent that the power station, unless prepared for such an emergency, can not meet the demand. The substations merely start additional rotary converters, but the load falls back upon the central station.

To combat this the Waterside Station has had mounted on its roof for several years wireless antennæ so arranged that the electrical impulses from a very distant thunderstorm are caused to ring a bell in an office below. When the storm is 100 miles away, and there are no visible signs of its presence the bell will ring every few minutes, with increasing frequency as the storm approaches, until finally when the storm may still be an hour away, the bell will ring constantly. This gives a warning of several hours, which is quite sufficient to call into service boilers which have been banked. Hence, when the storm breaks and the city calls suddenly for light these reserve boilers will have steam ready to turn additional dynamos and supply the required current.—*C. L. M.*

## THE AUDIBILITY OF THUNDER.

By C. VEENEMA.

(Abstracted from *Das Wetter*, June, 1917, pp. 127-130; Aug.-Sept., 1917, pp. 187-192; Dec., 1917, pp. 258-262; Mar.-Apr., 1918, 56-68.)

There are two methods of determining the distance of thunder sources—the first by measuring the actual distance and the second by determining the time interval between lightning and thunder. The first method requires at least two observers, or as many more as possible, who will report the time of first thunder, the time of nearest approach of the storm, and whether or not the storm passed directly over the observer. In this manner the path of the storm can be constructed very accurately, and the distance of the thunder determined for any time from a given station. This plan is not feasible for storms approaching from the sea or for those observed over the sea. There is also danger that the first thunder may be confused with other noises, or that the direction may be in error, but these difficulties are largely overcome with practice. The second method, that of determining distance by time interval between lightning and thunder, has advantages and disadvantages also. Only one observer is needed, and the results of his observation can be obtained at once. On the other hand, when there is continuous thunder and frequent lightning, especially at night, when other conditions for obtaining large values for thunder audibility are propitious, it is often difficult to associate a given peal of thunder with its proper flash of lightning. Moreover, the circumstances surrounding the observer must be favorable, or, as frequently happened to the author, the observation will be lost by the passing of a wagon, the roar of the wind, or the noise of the rain, after having counted seconds for a considerable period.

By almost continuous observation of thunderstorms from 1895 to 1916 the following distances occurred for a certain group of observations: On 9 occasions, between 30 and 40 kilometers; on 12 occasions, between 40 and 50 kilometers; on 2 occasions, between 50 and 60 kilometers; on 2, between 60 and 70 kilometers; on 2, between 70 and 80 kilometers; on 1, between 80 and 90 kilometers; and finally on 2 occasions over 100 kilometers. It is of interest to inquire what the maximum distance is, to which thunder could be heard under the most favorable conditions, but this question is dependent upon so many extraneous influences that it is difficult to answer. The author is led, however, to six conclusions, regarding the long distance audibility of thunder:

1. The loudest thunder comes from the strongest and loudest and downward-directed lighting.
2. The intensity of the sound and the degree of quiet surrounding the observer are strongly influential.
3. The evening and night hours appear more favorable for the propagation of sound than the day hours.
4. The wind direction, at least up to the cloud level, appears to have no influence.
5. In late summer and autumn, the audibility conditions are much more favorable than in spring and early summer.
6. The audibility of thunder is diminished by irregularities and turbulence in the atmosphere.

NOTE.—C. J. P. Cave, in *Nature* (London), October 16, 1919, notes cases where the time interval between flash and thunder was 120 seconds, 170 seconds, and 189 seconds, yielding a maximum distance of 63 kilometers. Capt. Ault, master of the *Carnegie*, has noted, in connection with the audibility of thunder at sea, that when successive intervals between lightning flash and thunder are recorded for a number of flashes, the storm became inaudible when the distance of the storm exceeded 5 miles (*Sci. Amer.*, May 20, 1916, p. 525).—*C. L. M.*

## ANOTHER CASE.

On October 16, 1919, at 5:43 and 5:44 p. m. (75th meridian time), looking northward from Chevy Chase, D. C., I observed two tremendous vertical lightning flashes reaching apparently from the overflow mammilated top cloud sheet of the thunderstorm. Brief growls of thunder (the only ones heard) followed in 140 and 132 seconds, respectively, indicating distances of 47 and 44 kilometers; the wind was moderate, southwest.—*C. F. Brooks.*

## THE VISIBILITY OF SOUND WAVES.

By FRANK A. PERRET.

[Abstracted from *L'Astronomie*, May, 1919, pp. 193-196.]

Several instances are described in which the sound waves emanating from terrific explosions in volcanoes have actually been made visible by variations in the refraction of light through them. The following explanation is given: " \* \* \* The sound is propagated in the air by means of compression and rarefaction waves, projected radially. The conditions for the production of these arcs are sudden explosions of great magnitude. If they are sufficiently violent, one can imagine that the waves of rarefaction and condensation would change the indices of refraction and reflection, and these zones would be visible by contrast. The visibility by contrast of zones of cold and warm air is well known, and we can easily conceive of an analogous

effect. It is a question of the *degree* of condensation and rarefaction. In short, an explosion produces in the air waves of compression and rarefaction which are perceived by the ear as sound, and also can be seen by unequal refraction, if they are sufficiently strong." These phenomena are seen as concentric circles about the point where the explosion occurs; generally, the top of a volcano.—*C. L. M.*

### PROPAGATION OF SOUND AND LIGHT IN AN IRREGULAR ATMOSPHERE.

[Reprinted from *Nature*, London, June 13, 1918, p. 284.]

I suppose that most of those who have listened to (single-engined) aeroplanes in flight must have noticed the highly uneven character of the sound, even at moderate distances. It would seem that the changes are to be attributed to atmospheric irregularities affecting the propagation rather than to variable emission. This may require confirmation; but, in any case, a comparison of what is to be expected in the analogous propagation of light and sound has a certain interest.

One point of difference should first be noticed. The velocity of propagation of sound through air varies indeed with temperature, but is independent of pressure (or density), while that of light depends upon pressure as well as upon temperature. In the atmosphere there is a variation of pressure with elevation, but this is scarcely material for our present purpose. And the kind of irregular local variations which can easily occur in temperature are excluded in respect of pressure by the mechanical conditions, at least in the absence of strong winds, not here regarded. The question is thus reduced to refractions consequent upon temperature variations.

The velocity of sound is as the square root of the absolute temperature. Accordingly for  $1^{\circ}$  C. difference of temperature the refractivity ( $\mu - 1$ ) is 0.00183. In the case of light the corresponding value of ( $\mu - 1$ ) is  $0.000294 \times 0.00366$ , the pressure being atmospheric. The effect of temperature upon sound is thus about 2,000 times greater than upon light. If we suppose the system of temperature differences to be altered in this proportion, the course of rays of light and of sound will be the same.

When we consider mirage, and the twinkling of stars, and of terrestrial lights at no very great distances, we recognize how heterogeneous the atmosphere must often be for the propagation of sound, and we need no longer be surprised at the variations of intensity with which uniformly emitted sounds are received at moderate distances from their source.

It is true, of course, that the question is not exhausted by a consideration of rays, and that we must remember the immense disproportion of wave lengths, greatly affecting all phenomena of diffraction. A twinkling star, as seen with the naked eye, may disappear momentarily, which means that then little or no light from it falls upon the eye. When a telescope is employed the twinkling is very much reduced, showing that the effects are entirely different at points so near together as the parts of an object glass. In the case of sound, such sensitiveness to position is not to be expected, and the reproduction of similar phenomena would require the linear scale of the atmospheric irregularities to be very much enlarged.—*Lord Rayleigh.*

### PROPAGATION OF SOUND IN AN IRREGULAR ATMOSPHERE.

By G. W. STEWART.

[Paragraph and synopsis reprinted from *The Physical Review*, vol. 14, No. 4, pp. 376-378. Article is reprinted in *Aeronautics*, Nov. 20, 1919, p. 467.]

Lord Rayleigh's recent reference<sup>1</sup> to and explanation of the "highly uneven character of the sound" from aeroplanes leads the writer to make a record of three additional facts.

Under poor atmospheric conditions, lower frequencies in aeroplane engine sounds become relatively enhanced; under good conditions frequencies of order of 1,000 d. v. are heard at greatest distances. The former is explained by irregularities in the atmosphere and the latter by characteristics of audition.

Intensity of the sound varies much more rapidly than as the inverse square, crude observations giving much more nearly inverse sixth and fourth powers for maximum ranges under fair and good listening conditions, respectively.

### SOME UNSOLVED PROBLEMS IN CANADIAN WEATHER.

[Reprinted from *Meteorol. Off. Circular*, Nov. 1, 1919, pp. 4-5.]

Previous to the meteorological luncheon at the Bournemouth meeting of the British Association for the Advancement of Science, Sir Frederick Stupart read a paper before Section A, on "Some unsolved problems in Canadian weather," making special reference to the climatic peculiarities of the Province of Alberta. He referred to the pressure and temperature conditions of two recent consecutive Januaries in which the mean temperatures at Calgary were  $16^{\circ}$  F. and  $47^{\circ}$  F., respectively. During the cold January the mean pressure of the month in the northwest of Canada was as high as 30.75 inches, but in the mild January only 29.97 inches. In the cold January there was intense terrestrial radiation and light northerly winds prevailed, but in the mild January with the low pressure, föhn (chinook) winds persisted, and the temperature in Alberta was high continuously. The föhn effect was due to the winds from the Pacific having to traverse four mountain chains so that they were dynamically warmed winds. In the discussion that followed Sir Napier Shaw pointed out certain objections that applied to the conventional explanation of föhn effects.

### CLIMATE OF THE BELCHER ISLANDS OF HUDSON BAY.

By ROBERT J. FLAHERTY.

[Excerpt from article on "The Belcher Islands of Hudson Bay" in *Geog. Rev.*, June, 1918, vol. 5, pp. 433-458 (pp. 453-454).]

The climate of the islands differs widely from that of the opposite mainland. Compared with weather reports from Great Whale River for the same period, our observations gave a far greater proportion of overcast skies and fogs, stronger and more constant winds, but higher and more equable temperatures. From October [1915] till early December winds of a velocity up to 50 miles were almost constant, and the sky was continuously overcast.

<sup>1</sup> See this REVIEW, p. 163.